

WHAT IS CLAIMED IS:

1 1. A method of determining a composition of an integrated circuit feature,  
2 comprising:  
3 collecting intensity data representative of spectral wavelengths of radiant energy  
4 generated by a plasma during plasma nitridation of an integrated circuit feature disposed  
5 on a substrate;  
6 analyzing said intensity data to determine a peak intensity at one of said  
7 wavelengths; and  
8 determining a component concentration of said integrated circuit feature based on  
9 said peak intensity.

1 2. The method as recited in Claim 1 wherein said integrated circuit feature is a  
2 nitrided gate oxide.

1 3. The method as recited in Claim 2 wherein said component is nitrogen.

1 4. The method as recited in Claim 1 wherein said one of said wavelengths is  
2 between about 290 nm and about 400 nm.

1 5. The method as recited in Claim 4 wherein said one of said wavelengths is about  
2 308 nm.

1 6. The method as recited in Claim 4 wherein said one of said wavelengths is about  
2 329 nm.

1 7. The method as recited in Claim 1 wherein said component concentration is related  
2 to said peak intensity as estimated by the equation  $y = -1.02E16 + 2.53E15 \ln(x)$ ,  
3 wherein x is said peak intensity and y is said component concentration.

1 8. The method as recited in Claim 1 wherein said method is an in-situ, real-time  
2 monitoring method.

- 1 9. A method of manufacturing a semiconductor device, comprising:  
2 forming an integrated circuit feature on a substrate;  
3 nitriding said integrated circuit feature using a plasma;  
4 collecting intensity data representative of spectral wavelengths of optical energy  
5 emitted by said plasma during said nitriding;  
6 analyzing said intensity data to determine a peak intensity at one of said  
7 wavelengths; and  
8 estimating a component concentration of said integrated circuit feature based on  
9 said peak intensity.
- 1 10. The method as recited in Claim 9 further comprising adjusting at least one  
2 parameter of said process based upon said intensity data analysis.
- 1 11. The method as recited in Claim 10 further comprising adjusting said parameter to  
2 achieve said component concentration at about  $1\text{E}14$  to  $5\text{E}15$  atoms/cm<sup>2</sup>.
- 1 12. The method as recited in Claim 10 wherein said parameter is one selected from  
2 the group consisting of: RF power, microwave power, pressure, and temperature.
- 1 13. The method as recited in Claim 9 wherein said integrated circuit feature is a gate  
2 oxide.
- 1 14. The method as recited in Claim 13 wherein said component is nitrogen.
- 1 15. The method as recited in Claim 9 wherein said method is an in-situ, real-time  
2 monitoring method.

1 16. The method as recited in Claim 9 wherein said one of said wavelengths is  
2 between about 290 nm and about 400 nm.

1 17. The method as recited in Claim 16 wherein said one of said wavelengths is  
2 selected from the group consisting of: about 308 nm, and about 329 nm.

1 18. The method as recited in Claim 9 wherein said component concentration is related  
2 to said peak intensity as estimated by the equation  $y = -1.02E16 + 2.53E15 \ln(x)$ ,  
3 wherein x is said peak intensity and y is said component concentration.

1 19. The method as recited in Claim 9 wherein said integrated circuit feature has a  
2 thickness ranging between about 13 Angstroms and about 17 Angstroms.

1    20.    A plasma system comprising:  
2            a plasma chamber for containing a plasma;  
3            means for controlling a plasma nitridation process of a feature on a semiconductor  
4    substrate located within said chamber;  
5            an optical sensor capable of detecting optical emissions from said plasma during  
6    said plasma nitridation process;  
7            an optical spectral analyzer for analyzing said optical emissions detected by said  
8    optical sensor to determine a peak intensity of at least one emitted wavelength; and  
9            means for determining a component concentration of said feature based on said  
10   peak intensity.